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## Understanding the Relationship between Suicide Rates, Exercise, Commute Drive, and Healthcare Provider

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Understanding the relationship between suicide rates, exercise, commute drive, and healthcare providers

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Population and Public Health

Scholarship in Medicine Final Report

☒ **By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission**

**Abstract**

Suicide is the tenth leading cause of death in the United States, with rates that have been rising significantly over the past decade, differing in varying states.<sup>1,2</sup> Although there is not a lot known about the specific causes of these trends, recent literature has found a dose-response relationship association between inactivity and poor mental health, self-harm, and suicidal attempt, indicating that physical activity may possess a protective nature.<sup>1,4</sup> Further expanding off this research, I wanted to investigate the relationships between rates of access to exercise, long commute drives, and healthcare providers to rates of suicide in 5 different states— to represent different regions in the country. Data was collected for five variables (suicide rates, access to exercise, long commute drive alone, primary care physicians, and mental health providers) in five states from the County Health Rankings website. Data was analyzed using

ANOVA with post hoc analyses and correlation studies. The results showed significantly different rates of suicide, access to exercise, long commute drive by counties between Ohio, Maine, New York, California, and Colorado. When looking at the correlation between access to exercise and suicide rates, there was a direct relationship found in Ohio, New York, and California. In regards to long commute drive, there was a direct relationship with suicide found for Ohio, but an inverse relationship found for New York and California. In Ohio, as the number of primary care physicians increases, suicide rates decrease. No relationship was found between mental health providers and suicide rates.

Key Words: Suicide, physical activity, long commute, primary care physician, mental health provider

## **Introduction**

Suicide is the tenth leading cause of death in the United States.<sup>2</sup> These rates have been rising significantly over the past decade, differing in varying states, with little known about the specific causes of these trends.<sup>3</sup> Financial life stressors, relationship burden, and poor physical health have been hypothesized to be contributing. There has been recent literature to support these claims, specifically poor physical health. In a study done by Boone and Brausch, the relationship between nonsuicidal-self injury and physical activity was evaluated.<sup>1</sup> It is known patients with nonsuicidal-self injury are at higher risk of attempting suicide. Their research found that low levels of physical activity had the greatest frequency of nonsuicidal-self injury.<sup>1</sup> In fact, not only are the two factors related, there is a dose-

response association between inactivity and poor mental health, self-harm, and suicidal attempt; indicating that physical activity may possess a protective nature.<sup>1,4</sup> There are many factors that contribute to low levels of physical activity. A longitudinal study performed by Nicholls, Phalen, and Miller concluded that long commute times to work were associated with poor physical activity and high rates of dissatisfaction.<sup>5</sup>

Certain life circumstances such as long commute drive, physical inactivity, or financial and relationship burden as mentioned before can all lead to poor mental health, and in some cases suicide. These circumstances can be identified by a primary care provider or mental health provider before the patient's poor mental health progresses to taking their own life. It is known that mental health providers are best equipped to take care those with mental illness and suicidal ideations; however, it has been found that most patients who commit suicide have seen a physician within the past year before their death, some studies even reporting within the past weeks to months.<sup>6</sup> Therefore, primary care is an ideal setting for early identification of suicide risk and initiation of care— becoming a major suicide prevention strategy.

It has been established that lack of exercise is associated with higher rates of suicide, but does merely providing access to these exercise opportunities have a relationship with suicide rates? In addition, long commute drives are proven to be related to lack of physical activity, which is related to increased suicide behaviors; but do long commute drives themselves have a relationship to suicide rates? These factors (access to exercise and long commute drives) vary depending on where someone lives, so it is important to investigate these two research questions listed in regard to varying states such as Ohio, Maine, New York, California, and Colorado. Lastly, receiving care from a primary care physician or mental health provider

should allow for early detection of suicidal behaviors and initiation of treatment, therefore lowering the rates of suicide in these patients. However, is just having licensed professionals enough to impact the suicide rates, or does the quantity of providers not matter? Is there a relationship between the number of primary care physicians and rates of suicide in Ohio? Is there a relationship between mental health providers and rates of suicide in Ohio?

## **Research Questions**

***RQ1:*** What are the differences in suicide rates, access to exercise, and long commute drive between Ohio, Maine, New York, California, and Colorado in 2020?

***RQ2:*** What are the relationships between access to exercise opportunities and suicides in Ohio, Maine, New York, California, and Colorado in 2020?

***RQ3:*** What are the relationships between long commute drive and suicides in Ohio, Maine, New York, California, and Colorado in 2020?

***RQ4:*** What are the relationships between number of mental health providers and primary care physicians and rates of suicides in Ohio in 2020?

## **Methods**

### *Context*

Data for this research project was used from the County Health Rankings website ([countyhealthrankings.org](http://countyhealthrankings.org)). Suicide rates were measured as the number of deaths due to

suicide per 100,000 population. The 2020 County Health Rankings used the National Center for Health Statistics mortality files data from 2014-2018 for this measure.

Access to exercise opportunities is measured as the percentage of population with adequate access to locations for physical activity, such as parks or recreational facilities. Individuals are considered to have access to exercise opportunities if they reside in a census block that is within half a mile of a park or reside in an urban census block that is within one mile of a recreational facility or reside in a rural census block that is within three miles of a recreational facility. The 2020 County Health Rankings used data collected from ArcGIS, SeLorme Map Mart, and ESRI from 2010 and 2019 for this measure.

Long commute-driving alone is measured among workers who commute in their car alone, the percentage that commute more than 30 minutes. The 2020 County Health Rankings used data from the American Community Survey from 2014-2018 for this measure.

The primary care physician measure is the ratio of population to primary care physicians. The 2020 County Health Rankings used the Area Health Resource File and AMA databases from 2017 for this measure.

The mental health provider measure is the ratio of population to mental health providers. The 2020 County Health Rankings used data from 2019 for this measure. Information for this measure was found through the National Provider Identification registry.

### *Data Collection*

Data was gathered from the County Health Rankings website. Different states were chosen to represent different regions in the country, with thought they would vary in exercise opportunities and duration of commute drive. California, Maine, and Colorado were chosen due to the increased access to outdoor exercise in these states, with less available in New York and Ohio. New York and California were chosen since they both have large cities, which usually indicates longer commute drives to work. There was no exclusion criteria.

### *Data Analysis*

Three ANOVA with posthoc tests compared the suicide rates, access to exercise, and length of commute drive in Ohio to those in Maine, New York, California, and Colorado (RQ1). To answer RQ2 and RQ3, access to exercise opportunities and long commute drives were correlated to the suicide rates in Ohio, Maine, New York, California, and Colorado counties in 2020 using a Pearson correlation. To answer RQ4, the number of primary care physicians and mental health care providers were correlated to the suicide rates in Ohio counties in 2020 using a Pearson correlation.

## **Results**

To answer RQ1, an ANOVA indicated significantly different rates of suicide by counties between Ohio (15.14%), Maine (18.88%), New York (11.57%), California (15.79%), and Colorado (26.12%) in 2020 ( $F_{4,257}=43.334$ ,  $p<.001$ ). Post hoc tests showed New York had

significantly lower rates of suicide than Ohio, Maine, California, and Colorado ( $p < .01$ ). In addition, Colorado had significantly higher rates of suicide than Ohio, Maine, California, and California ( $p < .001$ ) (Table 1).

**Table 1:** Suicide Rates in 2020 Among Five States

State	n	Mean	SD
Ohio	85	15.14% <sup>a,b</sup>	3.08%
Maine	16	18.88% <sup>a,b</sup>	3.30%
New York	61	11.57% <sup>b</sup>	3.20%
California	55	15.79% <sup>a,b</sup>	6.85%
Colorado	45	26.12% <sup>a</sup>	10.29%

Abbreviation: SD, Standard Deviation

<sup>a</sup>Statistically significantly different from New York ( $p < .01$ )

<sup>b</sup>Statistically significantly different from Colorado ( $p < .001$ )

A second ANOVA indicated significantly different rates of access to exercise by counties between Ohio (67.81%), Maine (61.95%), New York (79.09%), California (81.62%), and Colorado (76.28%) in 2020 ( $F_{4,283}=8.733$ ,  $p < .000$ ). Post hoc tests showed Ohio and Maine, although not statistically significant from one another, had significantly lower rates of access to exercise than New York, California, and Colorado ( $p < 0.05$ ).

**Table 2:** Access to Exercise in 2020 Among Five States

State	n	Mean	SD
Ohio	88	67.81%	19.10%
Maine	16	61.95%	14.95%
New York	62	79.09% <sup>a,b</sup>	14.92%
California	58	81.62% <sup>a,b</sup>	16.08%
Colorado	64	76.28% <sup>a,b</sup>	19.93%

Abbreviation: SD, Standard Deviation

<sup>a</sup>Statistically significantly different from Ohio ( $p < .05$ )

<sup>b</sup>Statistically significantly different from Maine ( $p < .05$ )



A third ANOVA indicated significantly different rates of long commute drives by counties between Ohio (33.12%), Maine (32.11%), New York (34.54%), California (32.75%), and Colorado (28.40%) in 2020 ( $F_{4,283}=2.594$ ,  $p<0.05$ ). Post hoc tests showed New York and Colorado had statistically significant rates of long commute drive, with New York having the highest rates of long commute drive and Colorado having the lowest rates of long commute drive.

**Table 3:** Long Commute Drive in 2020 Among Five States

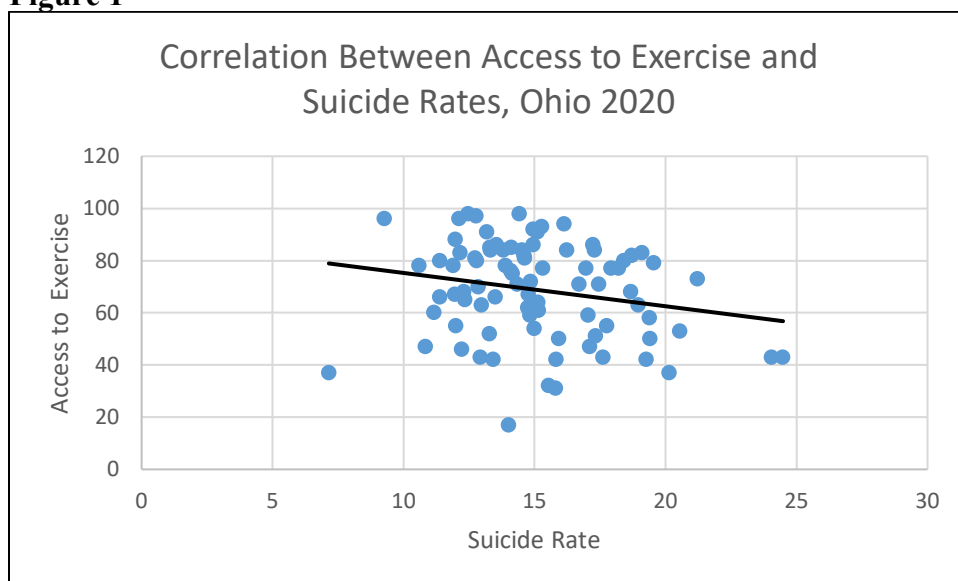
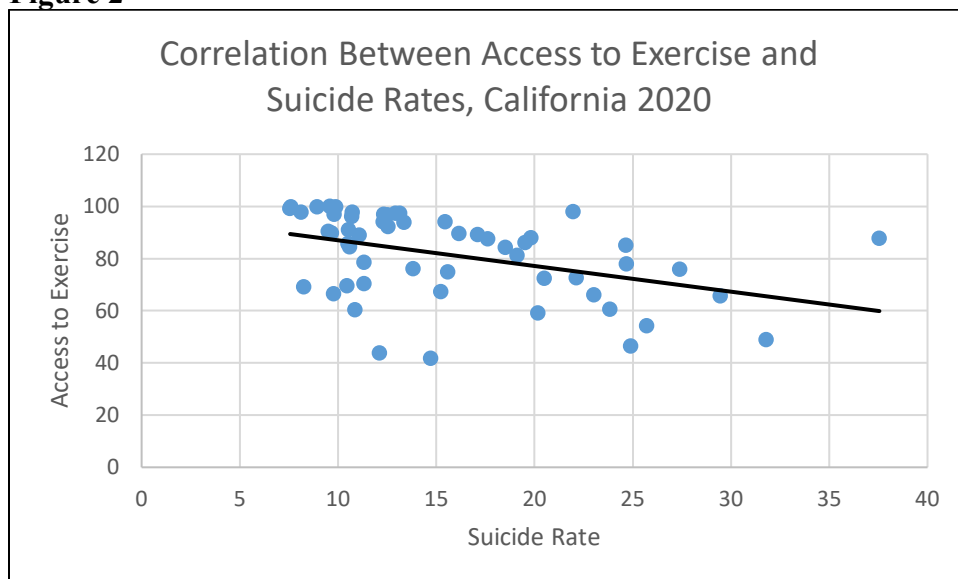
State	n	Mean	SD
Ohio	88	33.12%	9.64%
Maine	16	32.11%	6.93%
New York	62	34.54% <sup>b</sup>	11.19%
California	58	32.75%	11.15%
Colorado	64	28.40% <sup>a</sup>	14.56%

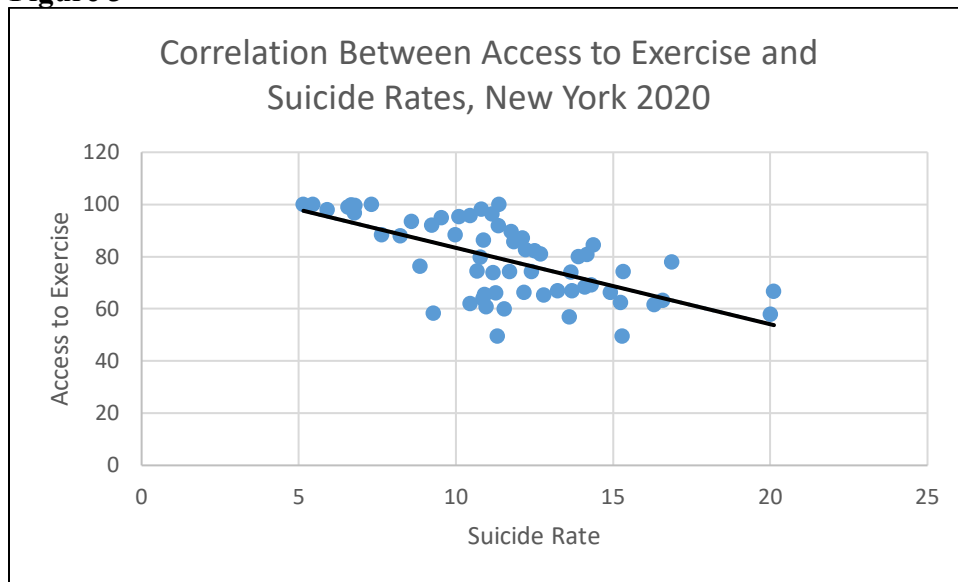
Abbreviation: SD, Standard Deviation

<sup>a</sup>Statistically significantly different from New York ( $p<.05$ )

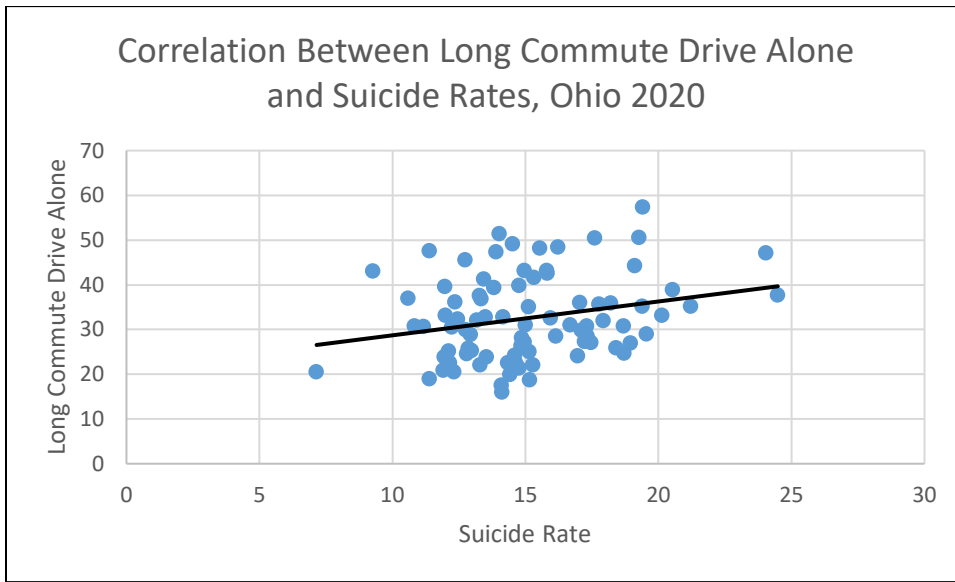
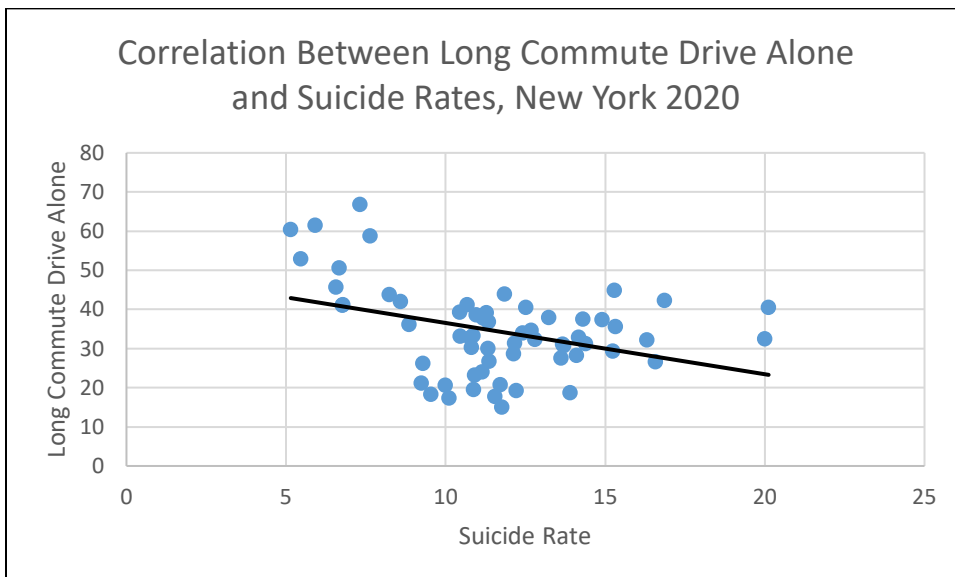
<sup>b</sup>Statistically significantly different from Colorado ( $p<.05$ )

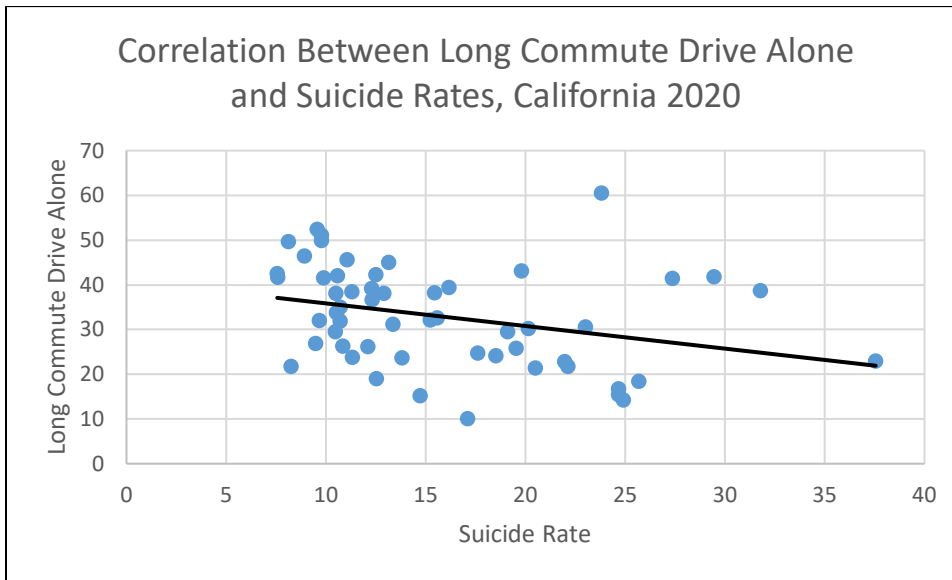
To answer RQ2, statistically significant correlations between access to exercise and suicide rates in multiple states for 2020 were discovered with Pearson correlations. There was a small, but significant correlation in Ohio ( $r=.214$ ,  $p=.049$ ) and California ( $r=.417$ ,  $p=.002$ )— where as the access to exercise increases, the rates of suicide decrease (Figures 1-2). There was an even stronger correlation in New York ( $r=.636$ ,  $p=.000$ )—again, where as the access to exercise increases, the rates of suicide decrease (Figure 3). There were no significant correlations between access to exercise and suicide rates in Maine and Colorado ( $p>.05$ ).

**Figure 1****Figure 2**

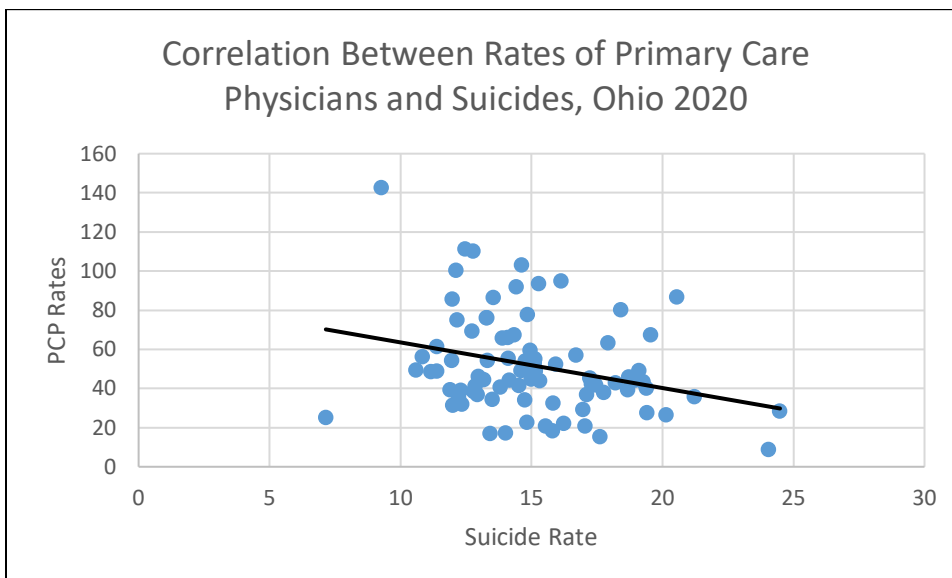
**Figure 3**

To answer R3, statistically significant correlations between long commute drive to work alone and suicide rates in multiple states for 2020 were discovered with Pearson correlations. There were small, but significant correlations in New York ( $r=.374$ ,  $p=.003$ ), and California ( $r=.311$ ,  $p=.021$ )— where as the percentage of long commute drives alone increase, the rates of suicide decrease (Figures 4-5). The opposite was found in Ohio ( $r=.249$ ,  $p=.021$ )— where as the percentage of long commute drives alone increases, the rates of suicide increase (Figure 6). There were no significant correlations between long commute drives alone and suicide rates in Maine and Colorado ( $p>.05$ ).

**Figure 4****Figure 5**

**Figure 6**

To answer RQ4, a Pearson correlation found a small, but significant correlation between number of primary care providers and rates of suicides in Ohio 2020 ( $r=.289$ ,  $p=.007$ ). As the number of primary care physicians increases, the rates of suicide decrease (Figure 7).

**Figure 7**

When further investigating RQ4, a Pearson correlation found no significant correlation between number of mental health providers and rates of suicide in Ohio 2020 ( $p > .05$ ).

## **Discussion**

Suicide rates have been rising, varying from state to state in the US, with little research investigating why there are such differences<sup>2</sup>. In looking at suicide rates between five states, it was found that the rates of suicides were statistically significant (New York having the lowest rates and Colorado having the highest of the states chosen for this study). The focus of the remainder of this research was to see if variables related to physical activity (exercise and commute time) were related to suicide and how these varied between the states.

Previous literature has determined that there is a dose-dependent relationship between physical inactivity and poor mental health, self-harm, and suicidal attempts indicating physical activity may even serve as a protective factor<sup>3,4</sup>. In fact, when investigating the relationship between suicide and access to exercise, statistically significant correlations were found in three out of five states (Ohio, New York, and California). Where, as access to exercise increases, suicide rates decrease. This research indicates that in the majority of states analyzed, lower rates of suicide are not only correlated to higher physical activity, but also access to physical activity. Comparing rates of access to exercise amongst all 5 states, Ohio and Maine, although not statistically significant from one another, both have statistically significant lower rates of access to exercise than New York, California, and Colorado. Since Maine's rates of access to exercise are lower, it could be possible that is why there is no correlation seen—although, that would not explain why Ohio does in fact show a correlation. Overall, these findings are important for future considerations regarding suicide prevention. It is great that exercise improves the risk of

not committing suicide, but it can be difficult for providers to convince their patients to consistently implement exercise in their routine since it is ultimately dependent on the patient's dedication. However, simply creating more access to exercise is a patient-independent way to lower the rates of suicide. This research supports creating more parks, or recreational facilities in future plans to target suicide in Ohio, New York and California. For Maine and Colorado, access to exercise might not be the answer, but can provide a good start—especially since Maine has significantly less access to exercise than some of the other states.

It has been previously demonstrated that long commute drives to work are associated with poor physical activity, and poor physical activity is related to increased rates of suicide<sup>5</sup>. However, when investigating the relationship between long commute drives and suicide rates in five states, the results varied. In Ohio, as the long commute drives increase, suicide rates increase—supporting the thought that driving longer leads to less physical activity which can lead to increased risk of suicide. In New York and California, the opposite was true. As the rates of long commute drives increased, suicide rates decreased. Comparing the rates of long commute drives amongst the 5 states revealed differences with New York and Colorado being statistically significant from one another—New York having significantly higher rates of long commute drives, and Colorado having significantly lower rates of long commute drives to work. Again, the low rates of commute drive in Colorado could be why there is no correlation when comparing it to suicide. With the inverse relationship seen in New York and California with commute drive and suicide, it poses the question of whether or not the methods of transportation have an impact. For example, in Ohio, where as rates of long commute drive increase, suicide rates increase, the main method of transportation is cars (the method of transportation measured in this study). In New York and California, where as the rates of long commute drive increase,

suicide rates decrease, the methods of transportation most commonly include subway, carpooling, etc. Since the variable “long commute drive” in this study includes only individuals who drive alone in a car for over 30 minutes, and no one using “social transportation”, the results could be skewed. For example, since the majority of California and New York use “social transportation”, perhaps the minority who drive a car (and would be included in this study), have lower rates of suicide since they are not having to deal with the stressors of “social transportation”. It could be that by avoiding social transportation all together, they are happier and have better mental health— therefore less rates of suicides. In addition, it is possible that people who drive cars rather than commuting via subway or train have different types of jobs and/or lifestyles, which could be influencing their mental health. Overall, although significant, the variation in the results makes it difficult to apply this research to the general US population at this time.

It is known there is a general lack of primary care physicians and mental health providers in the United States, leaving the patients with mental health diseases and suicidal ideations vulnerable<sup>7</sup>. Studies have shown that most patients who commit suicide have seen a primary care physician within the past week to year before their death<sup>6</sup>. When looking at the relationship between rates of primary care physicians to rates of suicide in Ohio 2020, there was a significant correlation. As the rates of primary care physicians increased, the rates of suicide decreased. This creates an opportunity for reform. Using this data, mental health organizations and companies can lobby to support/finance more primary care physicians to decrease the risk of suicide in that region. In addition, workshops can be held for primary care physicians regarding mental health—to remind them to investigate the possibility of suicidal ideation with each patient encounter. The relationship between rates of mental healthcare providers and suicide rates was



also investigated, although there was no significant correlation found—perhaps due to the fact most patients with mental health are seen only by primary care physicians. This further supports the need to train primary care physicians in mental health topics, since it is not feasible to rely solely on mental health providers to see every patient struggling with mental health.

## **Conclusion**

Limitations to this study include the access to exercise measurement, long commute drive alone measurement, and use of old data for multiple variables. The “access to exercise” measurement included only parks and recreational facilities. It was not inclusive of all exercise opportunities within a community—leaving out sidewalks (location to walk and run) and local schools (some have gyms/tracks open to the community). In addition, there are limitations to defining access. The parks could be in an unsafe area, difficult to enter (lack of signs, hidden entrance, busy street). Access also could include cost at some locations (entry fees, passes to recreational facilities). Second, the long commute drive alone measurement was taken off a survey. Some people may have not filled out the survey, thereby possibly not reflecting the true population. Lastly, County Health Rankings used data from years prior to 2020 for their 2020 data across all measures. For example, suicide rate data from 2014-2018 was used to create 2020 data.

Future directions include looking at more recent data to see if the same trends continue across all research questions, incorporating more states to see if the trends continue across multiple states, attempting to obtain more surveys for the long commute alone measure, and analyzing the safety and cost of the parks/recreational facilities to determining if people

actually have access. Access to exercise was only significantly correlated with three of five states researched. In these two states (Maine and Colorado), there must be other contributing factors to suicide rates. Further research needs to be done in regard to socioeconomic status, with the possibility of wealth or lack thereof playing a role in suicide rates. Lastly, a deeper investigation into the relationship between long commute drive alone and suicide rates is important due to the conflicting results in varying states.

Overall, suicide rates varied between specific states, with New York being the lowest and Colorado being the highest in the group of states used for this study (California, Ohio, and Maine in between). These results did not correlate with the results of access to exercise, further supporting the notion that what causes/prevents suicides is multifactorial—not just exercise dependent. It was found that there was an inverse relationship between access to exercise and suicide rates in three out of five states (Ohio, New York, California). In addition, there was a significant correlation between long commute drive alone and suicide rates in the same three states; although Ohio was a direct relationship (increase long commute, increase suicide) whereas New York and California were inverse (increase long commute, decrease suicide). Lastly, a significant correlation was found in Ohio with the rates of primary care physicians (PCPs) and suicide. As the number of PCPs increased, the suicide rates decreased. There was no significant association with mental health providers and suicide. As illustrated by this research, it is important that patients struggling with mental health not only exercise, but have the access to exercise. In addition, it is important to train new and upcoming PCPs to effectively treat patients with mental health.

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